# Bushland and Urban Biodiversity Management in a Changing Climate

# Final Project Report

This report forms part of the project
*"Bushland management and climate change:*
*Adapting management practices in response to landscape change"*
as developed by the Eastern Alliance for Greenhouse Action.

Updated May 2013

**David Simondson**

The Eastern Alliance for Greenhouse Action would like to acknowledge the contribution of David Simondson who was a founder of EAGA and instrumental in the early conception of this research project.

Sadly, David passed away prior to the completion of the project. This body of work leaves a fitting legacy to David's deep dedication to conservation of the unique Australian environment.

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# Executive Summary

Climate change represents a major issue for the Australian community, with many emerging risks, as well as opportunities. It is important that these risks and opportunities are understood at a local level, since regional differences in terms of socio-economic characteristics, physical environment and existing biodiversity will significantly determine local communities' vulnerability to climate change, as well as adaptation opportunities that are available to them.

As information about climate change becomes more readily available, on-ground biodiversity and bushland managers in Local Government are now faced with reconciling that information with their strategic and operational planning. Local Councils are generally charged with the task of managing much of the biodiversity and bushland assets within their areas. However, knowledge of how changes in climate will impact these assets is difficult for Local Government to attain within the existing resources and skill base. Therefore, it is important that councils work closely with State and Federal governments and research agencies to better understand the issues faced and form research partnerships to better plan for effective action. This also provides the new opportunity to discuss the high level science of climate change with the operational land managers. Essentially this means bringing the science out of the models and applying it in long term strategic planning and on-ground operations to find the most efficient ways of protecting natural assets in a changing climate.

Councils are beginning to consider the impacts climate change could have at the local level. This has brought six eastern Melbourne councils to form EAGA, the Eastern Alliance for Greenhouse Action.

In this project, EAGA has investigated the current understanding of the potential impacts of climate change on the ability of local governments to manage their biodiversity and bushland assets. It has also identified the challenges councils already face in this issue to determine what opportunities are available, where the knowledge gaps are and ultimately what further steps need to be taken to enable councils to successfully adapt management strategies to a changing climate.

The project evolved through four key steps.

The first step was a comprehensive 'Literature Review' of climate change issues relevant to the project area. This review pulled together information on climate change in general, how climate change is expected to affect Australia and more specifically Victoria, how it may impact on biodiversity (flora, fauna and ecosystems), and what role councils need to play in managing their natural assets in a changing climate.

The second step took the information from the Literature Review and investigated the projected climate change impacts for the EAGA region and interpreted the results to determine the potential impact on local biodiversity assets. This resulted in a 'Projections Paper'. A customised "Climate Futures" report for the EAGA region was provided by CSIRO for this review. In this report it was projected that the "most likely climate future" for the EAGA region includes increasingly drier and hotter climatic conditions with increasing intensity of rainfall events likely in summer and autumn seasons.

Given the information gained about the projections for climate change in the EAGA region it was then important to test this information with the EAGA councils to determine what the key challenges and opportunities were going to be, to better understand what the needs are in terms of enabling councils to best protect biodiversity and bushland assets in a changing climate.

The third step of the project was an investigatory workshop with EAGA councils resulting in the development of an 'Issues Paper'. The workshop provided the opportunity for expert speakers to

present information on climate change, how it can impact on biodiversity and the role of councils as land managers.  It also provided an opportunity to obtain first hand information from council employees working in a range of positions on the understanding of the issues, what the needs are, what are considered the key challenges for the region and what opportunities they perceive for improving their ability to tackle any issues arising.

The workshop and the development of the 'Issues Paper' also identified areas where local government requires additional information or expertise to use in strategic planning and operations for the best outcomes for biodiversity values.  Their needs were developed into a series of potential case study topics, one being chosen by the project steering committee for further development.  The purpose of this case study was to provide the EAGA councils with a tool for gaining better knowledge about how climate change may impact natural assets, thus allowing them to incorporate this information into long term planning.  It was also intended that the case study tool have the potential to be used more broadly by other councils and land management agencies.

The case study advanced the new relationship between climate scientists and local governments.  It attempted to increase understanding of the climatic resilience of a range of indigenous plant species in the projected climate change scenarios for 2020, 2050 and 2080 in the region.  This was done through new bioclimatic modelling at Macquarie University that determined the "climatic envelope" for each species to determine if those that live in the area now, will still have the climatic conditions required to survive in the long term.  This is an important issue as trees, in a street or a bushland setting, are expected to survive several decades and if suitable conditions for some species will no longer exist in areas where they occur currently, there could be substantial financial and environmental impacts for councils in the future.  The "climatic envelope" for the 21 key plant species used in the case study have been provided to the EAGA councils where they can now analyse the information within their local context.  This will allow them to determine how their biodiversity assets may be impacted and allow them to implement long term planning or immediate actions to help protect those assets.

This project has been a valuable first step in helping enable councils to understand, plan for and act to help maintain their biodiversity and bushland assets in the long term.  It has effectively created partnerships between councils, with other land management agencies and with research institutions.  While many challenges have been identified, many opportunities have arisen and the Case Study has delivered one initial tool to help councils consider the potential impacts of climate change on natural assets.

The next challenge is to effectively share the information learned in this project, both internally and externally within the EAGA councils and their regions and to continue to work towards fulfilling the needs of councils identified in this project to enable them to turn their challenges into opportunities for the most effective protection of their biodiversity and bushland assets in a changing climate.

**Key Project Outcomes:**
- Advanced understanding of projected climate change impacts in the EAGA region leading to increased awareness of potential future challenges for managing bushland and biodiversity assets in the region.
- Increased collaboration between the 6 EAGA councils to understand potential climate change impacts in the region and assess future challenges and opportunities to work together.
- Interaction with EAGA councils and community to determine the current level of understanding and engagement in issues around climate change and biodiversity and bushland protection.
- Testing of a 'bioclimatic envelope' modelling tool to help predict likely changes affecting key plant species in the EAGA region at several time steps, to determine the resilience of these species and allow for planning future planning for vegetation management, enhancement and conservation.

# 1. Introduction

**Project Background**

The Eastern Alliance for Greenhouse Action (EAGA) was established in 2008, to provide a regional framework for local stakeholders to work together on climate change and greenhouse gas projects in the eastern suburbs of Melbourne, Victoria. The EAGA committee includes representatives from Boroondara City Council, Knox City Council, Monash City Council, Maroondah City Council, Whitehorse City Council and the Yarra Ranges Council. The current project is managed by a steering committee including representatives of four of the six EAGA councils, a representative of the DSE and the project officer.

**Project Objectives**

Climate change represents a major issue for the Australian community, with many emerging risks, as well as some opportunities. It is important that these risks and opportunities are understood regionally and locally, since regional differences in terms of socio-economic characteristics, physical environment and existing biodiversity will significantly determine local communities' vulnerability to climate change, as well as adaptation opportunities that are available to them. Conversely, if local and regional land managers are to be in a position to prepare for and adapt to climate change, then it is essential that they are kept well informed about the issues and are fully consulted about relevant matters.

"Bushland and urban biodiversity management in a changing climate" is a project implementing the first stage of a program to assist councils to better manage biodiversity assets on public and private land within their municipalities.

**The objectives of the project are to:**

1. Document the needs, issues and opportunities for local government to enable them to support species and ecosystems to adapt to climate change – with a strong focus on biodiversity and bushland management on public and private land; and

2. Identify knowledge gaps to enable local government to manage public and private land biodiversity in a changing climate.

# 2. Investigating the scale and nature of the problem & implications for councils

Investigation into the scale and nature of the climate change problem and impacts on biodiversity were researched through the development of a comprehensive literature review. This review pulled together information from the scientific reports, peer reviewed journals, conferences and papers regarding climate change and its impacts on biodiversity. The role of local government in biodiversity and bushland management, and areas whereby local government can have the greatest influence over bushland management in response to climate change was then investigated. This was then further investigated with the interactive workshop.

## Literature Review – Appendix 1

**Report Outline**
1. The Global Context
   a. Projecting the future
   b. Climate Change in Australia
   c. Climate Change projections for Victoria
2. Biodiversity and Climate Change

3. Climate Change, Biodiversity and Fire
4. Local Government and Community Engagement
5. The Urban Heat Island Effect

**Key Points in the Literature Review:**

- The Australian, Victorian and the majority of Victorian local governments accept that climate change is occurring and is influenced by human activity. Temperatures will continue to increase for at least the next two decades due to inertia within the climate system.

- Habitats and species have already begun to respond to the initial effects of a changing climate but most scientists agree that the current and expected rate of change is much greater than most natural systems will be able to naturally adapt to. In addition to this, extreme climatic and climate related events such as floods and bushfires, can have catastrophic consequences for regional biodiversity.

- The details of "on the ground effects" of climate change are impossible to predict with confidence. Adaptive management strategies in response to changes will need to be employed by land managers. As climate change impacts develop, it may not be possible to support some species where they historically occur.

- If biodiversity is to have any prospect of adapting to climate change, landscape connectivity will need to be enhanced by management decisions and further fragmentation of the landscape avoided.

- To better support species and ecosystems to adapt to climate change, local government will have important roles advocating for appropriate policy, in mitigation of climate change and in adaptation to its inevitable effects.

- Green spaces and biodiversity confer a number of benefits on local communities. Management will need to be responsive to the values the community places on those benefits. It will be necessary to identify, assess and prioritise those attributes to direct changes to bushland and urban biodiversity management and planning.

- Climate scientists have described a number of feedback effects, which will reinforce climate change if they are triggered. If that occurs, self-sustaining 'runaway' climate change may follow and it will no longer be possible to stop this process.

- The emissions trajectory which humanity will choose remains undecided. Current policies make it seem unlikely that we shall avoid the runaway trajectory and escape massive damaging changes.

- Without global agreement on, and implementation of, urgent and effective action to reduce greenhouse emissions in the near future, massive biodiversity losses will be unavoidable. It is essential for nations to act to mitigate the most extreme effects of climate change. There is ultimately no substitute for rapid and deep cuts in global emissions of greenhouse gases.

The information learned through the Literature Review provided a context for an interactive workshop and further discussion that helped clarify understanding of the issues which must be confronted for councils to successfully plan and adapt bushland and urban biodiversity management techniques in response to climate change.

**Methods**

In order to make the present study as comprehensive and current as possible, sources have not been limited to published peer-reviewed papers. A variety of sources were utilised including peer-reviewed journals, government and agency reports which draw upon published papers and media reports which quote authoritative sources or contribute relevant information not otherwise available. Some documents have been obtained through personal communication and networking opportunities.

**Outcomes**
- A comprehensive review of the current climate change issues and specific elements that may impact on councils and in particular within the EAGA region.
- A snap shot of climate change information that provides a strong starting point for councils to understand the challenges of managing natural assets in a changing climate.
- This information has lead to the development of the interactive workshop to investigate the challenges and opportunities councils are faced with. These issues and options are captured as part of the Issues Paper and Case Study development later in this project.

**Challenges**

Climate Change is a complex issue. Much of the information is written for those with expertise in the issue, is presented in large volumes and can be difficult to access. Given the complexity of the information, it was challenging to communicate the information in a succinct and understandable way so that the project could advance but also without losing the complexities of the issue. Additionally, much of the information is focussed at a large scale and is not always easy to apply to a specific region. New information was continually arising over the life of the project requiring constant review, document updating and communication of new information.

**Opportunities**

This comprehensive review provided the opportunity for the Project Officer to contact climate change scientists directly leading to deeper discussion of issues and new leads on current studies. It also assisted with the development of the workshop by identifying appropriate speakers and opportunities for more tailored climate science to be conducted (e.g. the development of a customised CSIRO report, Climate Futures for the EAGA Region). Review of the current literature also assisted with the identification of seminar opportunities for EAGA to attend to gain further insight and also to promote the project.

# 3. Identification of knowledge gaps, research needs and the impact on bushland and biodiversity management

After the initial investigation of climate change issues in the Literature Review, it was then important to provide this information in a more specific context. This review considered how the changes in climate may impact biodiversity and bushland assets in the EAGA region and helped understand how councils could plan for adaptive management in response to the projected changes.

To enable this, a Climate Change Projections Paper was prepared. In this report specific CSIRO climate modelling was considered for the EAGA region alongside broader knowledge of how changes in climate can affect local biodiversity. This more specific information was then used to formulate lines of investigation for the interactive workshop. This allowed for a more targeted process of understanding what councils understand about the challenges faced in managing natural assets in a changing climate, and what is needed in terms for further knowledge and tools to meet the challenges.

## Projections Paper - Appendix 2a

**Outline**
1. Climate Change Predictions for the EAGA Region

2. Projected Impacts of Climate Change on biodiversity
   - Dimensions of climate change in the EAGA Region
   - Compounding Factors
3. Impacts on Ecosystems
   - Types of Impacts on Ecosystems
     - Ecosystem distribution
     - Ecosystem composition
     - Ecosystem function
     - Ecosystem services
   - Ecosystem Types in the EAGA Region
   - Impacts on Species
     - Changes in Distribution
     - Changes in Population Status
     - Mechanisms or Causes Impacting Species in relation to Climate Change
     - Characteristics and Factors contributing to Vulnerability or Resilience
   - Impacts on Ecological Interactions
   - Feedbacks to Climate
4. Biodiversity Conservation in a changing climate
   - Building Resilience
   - Proactive Interventions
   - Flexible Policy and Management Approaches
5. Recommendations – Adaptations to changing climatic conditions
6. Key messages and policy directions
   - Reform council management of biodiversity
   - Strengthen the National commitment to conserve Australia's biodiversity
   - Invest in our life support system
   - Build innovative and flexible governance systems
   - Meet the mitigation challenge

**Summary**

Councils are a key stakeholder group in the context of a regional response to the potential impacts of climate change on biodiversity. They are major public land managers and providers of environment and community services in their municipalities and play a crucial role in facilitating community awareness, networking and response to the issue.

In many cases councils are at the front line of natural resource management on both public and private land, and therefore have a very important role to play in biodiversity management. Councils are managers of public land, regulators of development and planners for land use and patterns of development and have the most relevant local knowledge about biodiversity protection on private land. Councils lead by demonstrating environmentally responsible behaviours, and provide support for private land-holders in the form of education, training and capacity building. Some councils also engage through incentive programs and schemes.

Summary results of the CSIRO Climate Futures modelling for the EAGA Region (Appendices 2b and 2c):

| Summary of most likely projected future changes |
| --- |
| *Temperature* |
| • *Average temperatures will increase in all seasons, most significantly in summer and least in winter.* |
| • *The frequency of hot days will increase.* |
| • *The frequency of warm nights will increase in all seasons, but most in summer.* |
| *Precipitation* |

- *With higher emissions into the future there are likely to be decreases in average rainfall in all seasons.*
- *The majority of the models project greatest percentage decreases in average rainfall to occur in spring.*
- *There will be increases in evaporation across all seasons with most models indicating the largest increases will be in winter.*
- *Projected decreased rainfall and increased evapotranspiration is likely to lead to decreased average streamflow.*
- *The frequency of dry days will increase.*

*Relative humidity*
- *By 2030 a decrease in annual average relative humidity of around 0.8% (+0.2 to -1.8%) is likely.*
- *By 2050 decreases in annual average relative humidity of around 0.5% (0.2 to 1.0%) and around 2.7% (-2.0 to -3.6%) are likely under low and high emissions scenarios respectively.*
- *By 2070 decreases in annual average relative humidity of around 2.7% and around 4.1% (-1.8 to -5.2%) are likely under low and high emissions scenarios respectively.*

*Fire Weather*
- *The frequency of weather conditions conducive to high forest fire risk will increase.*
- *The fire season will start earlier and end later in the year.*

*Extreme Wind Speeds*
- *The majority of models indicate extreme wind-speeds could decrease in spring, summer and autumn and increase in winter.*

*Solar Radiation*
- *By 2030 an increase in annual average solar radiation of around 0.8% (0.1 to 1.6%) is likely.*
- *By 2050 increases in annual average solar radiation of around 0.9% (-0.1 to 1.9%) and around 2.7% (0.6 to 4.8%) are likely under low and high emissions scenarios respectively.*
- *By 2070 increases in annual average solar radiation of around 0.6% (0.4 to 2.5%) and around 3.1% (0.5 to 5.4%) are likely under low and high emissions scenarios respectively.*

**Projected Changes in Ecosystems**
It was projected that some ecosystems (in the configurations we know them now) may be lost at local levels (council level or EAGA region) or their range may contract or move, particularly those reliant on water (e.g. wetlands). It is also projected that ecosystem species composition will change with some species unable to adapt and others able to respond and adapt to new niche areas. Ecosystem functions are also projected to be impacted with potential changes in nutrient cycles and disease spread (e.g. *Phytophthora cinnamomi*).

**Projected Impacts on Biodiversity**
It is projected that in response to a changing climate there will be changes in species phenology (e.g. timing of leaf unfolding, flowering date, migration and time of reproduction), species distributions, community structure, species interactions, changes in ecosystem functioning and productivity. The impact of profound changes in species phenology has repercussions for not only the species facing change, but all of the other species that have adapted to share the surrounding ecosystem with it, creating potential for total ecosystem collapse.

Climatic conditions (e.g. temperature and precipitation) determine suitable habitat for certain species, such as Australian eucalypts. Rapid changes in climatic conditions are therefore likely to change the geographic extent of species distributions, resulting in latitudinal and/or altitudinal shifts and/or contractions of species' ranges. This poses challenges for the management of street trees and parklands and for revegetation actions by EAGA councils, with further research required to determine which tree

species are most likely to survive predicted changes to local climates and what are the long term impacts for species most at risk and ecosystems in which they dominate.

Some species may be unable to disperse or adapt fast enough to the high rates of climate change. These species face increased extinction risk, and, as a result, whole ecosystems may cease to function in their current form. This will have an impact on biodiversity and bushland. Long term planning and consideration of what species are most likely to survive projected climate change will be required.

It is clear from the research conducted to date that the EAGA region can expect changes in ecosystems and species assemblage in the long term future under plausible climate change scenarios. Therefore it is important for the EAGA councils to gain a better understanding of what elements of ecosystems are most vulnerable to the changes, and what flow on affects are likely to have on other species if the abundance and/or distribution of the ecosystems are altered as a result of climate change. EAGA councils will also need to gain an understanding of species which will benefit from the projected changes in climate and may outcompete or replace other species over time. (e.g. which weed species will benefit from the projected climate changes and become increasing problems, and therefore should be a key focus of current control and eradication programs).

The climate projections report provides many lines of investigation for councils to consider in terms of enhancing the ability to effectively manage biodiversity and bushland assets in a changing climate. The information learned in this part of the project was further developed for the interactive workshop. This allowed the workshop to test the level of understanding and the knowledge gaps in the EAGA councils, assess the key issues these councils are facing in their ability to adapt to changing climatic conditions and their needs for additional research and information to help support accurate and efficient long term planning.

**Methods**
The climate projections report included data from a range of broader research projects into the impacts of climate change on ecosystems and biodiversity. The project focussed, where possible, on more specific climate change projections for the EAGA region, obtained through a dedicated Climate Futures report prepared by CSIRO.

**Outcomes**
With most climate change projection information at a broader scale (i.e. state level data), it was very valuable to obtain a regionally-focussed CSIRO Climate Futures report for the EAGA Region. The projections have provided more accurate understanding of the likely future climate conditions that the EAGA councils can monitor over time. This information has broader significance to the EAGA councils, informing on other related climate change impacts on areas such as built environments, infrastructure, community planning, emergency services, economic (industry) impacts and social impacts.

**Challenges**
Much of the published information currently available about the impacts of climate change on biodiversity is written for an academic audience and required some interpretation to make it available for a non-specialist audience.

**Opportunities**
Through effective networking the project was able to obtain a customised Climate Futures report from CSIRO. This allowed for the most current and accurate climate projection information for the region to be considered. Through this relationship the CSIRO provided an expert presenter for the workshop, to explain the modelling approach and interpretation of the results.

**Appendix 2b:    CSIRO Climate Futures for Eastern Melbourne**
**Appendix 2c:    CSIRO Climate Futures spreadsheet**

# 4. Identifying local government needs, issues and opportunities

The third stage of the project was to present findings to the EAGA councils and further explore the current level of understanding of these issues, the needs of the councils to manage these issues (including assessment of key barriers) and identify key challenges and opportunities for consideration in long term planning and associated actions. A full day workshop was run for the EAGA councils including representatives from community groups and other land management agencies working on biodiversity and bushland management within the EAGA region.

To frame the breadth of issues being discussed in the workshop and to provide scientific context to the afternoon session discussions, the morning session consisted of presentations from five climate change researchers who presented on climate change, impacts on biodiversity and the role of councils.

The outcomes of the workshop, in conjunction with insights gained in the Literature Review and the Projections Paper, informed the development of an Issues Paper. The Issues Paper outlines the issues, challenges and opportunities for the EAGA councils impacting their understanding and ability to manage biodiversity and bushland assets in a changing climate.

## Interactive Workshop

The Interactive Workshop was held on 30th July 2010 at the Karralyka Centre in Ringwood, Victoria. The purpose of the workshop was to disseminate information about climate change projections for the EAGA region to councils and to explore and discuss the challenges and opportunities.

### Workshop participants

Representatives from each of the six EAGA Councils were invited to attend the workshop, with the objective of obtaining a cross-section of attendees including councillors, a range of relevant service areas within each Council (including: environmental management; infrastructure provision; planning; social and community services), community representatives and other relevant agencies.

In total, fifty-two stakeholders participated in discussions and contributed to the project feedback forms. This included thirty-six representatives from five local governments in EAGA and sixteen representatives from other agencies including scientific institutions and state government. A full list of participants is included in the Issues Paper (Appendix 3).

### Workshop Process

In the morning a series of background presentations was given. This session was introduced and facilitated by Dr Rodney van der Ree from ARCUE (Australian Research Centre for Urban Ecology).

### Speakers:

Professor Neville Nicholls – Monash University
Climate Science and misrepresentation in the media

John Clarke – CSIRO Climate Futures Program
Overview of climate modelling and specific projections for the EAGA region

Dr Lynda Chambers – Bureau of Meteorology
Impacts of climate change on biodiversity

Peter Codd – Department of Sustainability and Environment
The Victorian government's White Paper and local government

Madeleine Barton – University of Melbourne
Impacts of climate change on the Common Brown Butterfly in the EAGA region

**Facilitated Workshop:**
Professor Gregory Moore from University of Melbourne introduced and facilitated the afternoon workshop session. Participants were grouped broadly according to their local government area and asked to discuss and answer the following questions:

1. What is the current role of Local Government Authorities (LGAs) in biodiversity and bushland management?
2. How do LGAs understand their biodiversity and bushland assets?
3. How does your council access, understand and respond to climate change information and issues?
4. In what areas do you think LGAs can have the greatest influence over biodiversity and bushland management in response to climate change?
5. What do you see as the current barriers to you successfully adapting your bushland and biodiversity management to changing climate issues?

Each workshop table of participants was provided with prepared sheets for noting responses. The sheets included spaces for recording "Gaps" and "Opportunities". Groups were also asked to record ideas for case studies that arose from discussions. Finally, participants were invited to complete an individual evaluation sheet and relevant responses were considered in preparation of the Issues Paper.

**Outcomes:**
Overall this forum was a very effective way to engage many different levels of council (land management, Councillors, executives and operational staff), in discussing the potential impacts climate change may have in the EAGA region and how that will affect the ability of councils to continue to effectively manage bushland and biodiversity assets. However, the majority of participants were from operational roles and planning departments of councils with fewer representatives from the councillor and executive levels. This was problematic as engaging with executive levels, or the 'decision makers' of organisations, is key to gaining support for reviewing the strategic and operational response of councils to climate change.

Some of the main findings included:

- Councils do not hold detailed knowledge about the potential climate change impacts in their area.
- Many councils are not resourced to seek or respond to scientific information.
- Councils are unable to predict how changes in climate will impact on existing bushland and biodiversity assets and therefore are having trouble planning for these impacts.
- There is great disparity within councils as to who plans for and controls long-term bushland management. For example, many councils had awareness at the on-ground officer level, but little at the management and planning level.
- Councils are resource limited, therefore they need to be as accurate and efficient as possible in their management actions, which means they need to have access to best available information and do accurate planning.
- Working together to understand impacts on shared vegetation types or fauna habitats would be appreciated and provide some economies of scale. The process of coming together for a workshop was effective in bringing EAGA councils into contact with each other and discussing similar issues.

The top three **Case Study** suggestions from workshop participants were:

1. **Which indigenous flora species will survive in a hotter climate?**

Investigate the 'climatic envelopes' of indigenous species, in particular key tree species trees, to help determine which species are likely to survive in the long term and which may not, and the resulting implications for managing biodiversity and bushland assets. *This recommendation was accepted by the EAGA Steering Committee as the Case Study topic.*

2. **What weeds will become more pronounced with climate change?**
   Investigate the 'climatic envelopes' for key weed species to help predict which ones will flourish in a warmer and drier climate and therefore may need greater control measures now.

3. **Value of biodiversity project – Investigate the economic value associated with bushland reserves to our community.**
   To provide an additional tool for engaging the community and upper management in bushland conservation (may include heat islands research).

A full summary of workshop responses is included in the Issues Paper (Appendix 3).

Workshop participants were asked to evaluate the usefulness of the workshop. Overall evaluations were highly favourable with participants finding it a useful exercise in the following areas:

- It increased understanding of the potential impacts climate change could have on biodiversity within the EAGA region.
- It increased understanding of the role in biodiversity management under those changing climatic conditions.
- Helped to identify the challenges and potential opportunities for managing biodiversity assets.
- Provided councils with direct links to current climate change modelling and projections.
- Generally the level of information presented was appropriate for the needs, but for some participants the presentations were a bit too 'scientific'.
- Allowed for intra- and inter-organisational discussions about role and responsibilities in managing biodiversity in a changing climate.
- Showed the ability of research institutions to be relevant and accessible contacts for councils.

A full summary of workshop participant feedback in included in the Issues Paper (Appendix 3).

## Issues Paper - Appendix 3

The purpose of the Issues Paper was to analyse and summarise the responses garnered by council representatives at the interactive workshop and integrate them with the overall project learning to understand more about the challenges and opportunities for councils managing their natural assets in a changing climate.

**Summary**

It is clear there is a very varied understanding of climate change and how it may impact biodiversity values in each council.
- Some councils are already fully engaged/resourced in the climate change issue and others are not.
- Collaboration is a very beneficial way for EAGA councils to continue to understand and tackle issues of natural asset management in a changing climate as they share similar types of biodiversity assets and organisational structures that should allow opportunities to work together leading to better efficiency outcomes and potential cost savings.
- Generally, climate change is an issue not actively considered at the local government level beyond energy and water efficiency.

- This project has provided valuable insight into how the EAGA region can further understand the impacts of climate change and provides an avenue for the consideration of long term management options to best protect and conserve their biodiversity values.
- To date, councils are generally lacking in tools and resources to fully understand the issues relevant to managing biodiversity assets in a changing climate.

Many ideas for Case Studies for the 4th stage of this project were discussed at the workshop. It was found that many EAGA councils had similar needs for additional information or tools to help, which allowed for some clear Case Study options to be considered by the Steering Committee.

**Outcomes**
- The interactive workshop was an excellent way for EAGA councils to interact on the issues of climate change. The workshop was attended by five EAGA councils, and all levels from resource management staff/operational to the mayors were represented.
- The expert presentations provided an opportunity to further engage council representatives on climate change projections and potential impacts for biodiversity assets within the region.

**Challenges**
While most EAGA councils were represented at the workshop, not all were well represented at all levels. In some councils executive level employees were engaged whereas other councils did not engage with this issue at an executive level. Representation was often left to the operational staff who recognise the significance of this issue on their daily work, but require support from more senior levels if resources are to be allocated to make the changes necessary to tackle the problems confronted.

**Opportunities**
This was a key opportunity to raise the issue of councils incorporating knowledge of climate change into management of natural assets, to share information of the projections specific to their region, to introduce key scientists, to explain techniques of climate science and to allow councils to provide input into needs, challenges and opportunities for long term management of their natural assets in a changing climate. Given the EAGA councils are all in the same region, and many share similar Ecological Vegetation Classes and flora and fauna species, there are significant opportunities to work together to understand the potential impacts climate change could have on biodiversity assets, and to work together to develop a better understanding of appropriate management techniques, such as 'adaptive' management.

# 5. Testing the current level of knowledge

The scope of the project allowed for a Case Study to be conducted investigating one tool that could inform the EAGA (and other) councils to better enable them to effectively manage biodiversity and bushland assets in response to a changing climate. The interactive workshop and Issues Paper provided several suggestions for a Case Study that would be beneficial to all EAGA councils given similarity of biodiversity assets.

The Steering Committee decided on a Case Study topic that could benefit all of the EAGA Councils and chose to investigate the "climatic envelopes" of key indigenous plant species found in a range of significant Ecological Vegetation Classes (EVCs) in the EAGA region. These climatic envelopes may determine the spatial area a species can be expected to endure in, given projected climate change. Knowing this will assist councils to manage bushland assets and consider what impact loss of certain species would have on the integrity of ecosystems and biodiversity in their area.

## Case Study - Appendix 4
Investigation of Potential Effects of Projected Climate Change on EVCs and Selected Key Species in the EAGA Region of eastern suburban Melbourne

**Outline**

The research for this study was conducted in several stages, each stage involving different contributors; identification of EVCs in the region, listing of species present in those EVCs, selection of species for modelling, bioclimatic modelling and interpretation.

For each species a set of maps was produced showing the recorded distribution, the modelled current zone of suitable climate and projections of future climatic suitability using four different bioclimatic models at three time steps, 2020, 2050 and 2080.

Changes between the current modelled climatic zones and the future zones were then examined to determine which species were subject to most change and were considered most vulnerable. The results were grouped by EVC to clarify the possible effects of change on vegetation communities.

**Summary**

The computer modelling projected changes in the distribution of suitable climatic zones, at all time steps, for all species modelled, in some parts of their ranges. The modelling does not indicate any general southward movement of the climatic zones, as might be expected. The projected movements in the EAGA region tend to be toward the North-East, which may be related to the increasing altitude of the Great Dividing Range in this area or to shifts in rainfall patterns.

It will be important to monitor all EVCs for early signs of changing populations, such as changes in seedling establishment. Baseline data needs to be established so that any changes can be identified. Species of particular concern in the EAGA region are *Eucalyptus ovata, E. rubida* and *E. regnans*.

Councils will need to develop policies regarding the valuing and maintenance of EVCs in their municipality. They will need to consider whether intervention is necessary, desirable and/or possible to maintain some EVCs and in what circumstances intervention would be considered.

This study showed that Bioclimatic Modelling has value in projecting the potential effects of climate change on species. This may assist councils in allocation of resources to manage and preserve bushland and biodiversity values.

Species modelled were:

| | | | |
|---|---|---|---|
| *Eucalyptus camaldulensis* | River Red Gum | *Acacia dealbata* | Silver Wattle |
| *E. cypellocarpa* | Mountain Grey Gum | *A. melanoxylon* | Blackwood |
| *E. obliqua* | Messmate Stringybark | *Coprosma quadrifida* | Prickly Currant |
| *E. macrorhyncha* | Red Stringybark | *Melaleuca ericifolia* | Swamp Paperbark |
| *E. viminalis* | Manna Gun | *Spyridium parvifolium* | Dusty Miller |
| *E. ovata* | Swamp Gum | *Exocarpos cupressifomis* | Cherry Ballart |
| *E melliodora* | Yellow Box | *Olearea argophylla* | Musk Daisy-bush |
| *E. cephalocarpa* | Mealy Stringybark | *Dicksonia antarctica* | Soft Tree-fern |
| *E. regnans* | Mountain Ash | *Tetrarrhena juncea* | Forest Wire-grass |
| *E. rubida* | Candelbark | *Themeda triandra* | Kangaroo Grass |
| | | *Phragmites australis* | Common Reed |

**Outcomes:**

The Case Study delivered a very useful and widely accessible model for councils to help determine which of their key plant species are vulnerable to projected climate change within the EAGA region, thus allowing more informed land management planning.

There is the potential for the EAGA councils to engage the method further or for other councils to access similar information. It provides an excellent link between climate change science and on-ground land management.

**Challenges:**
The large number of contributors to this project increased the challenge of coordinating inputs. In addition, the initial bioclimatic modeller was unable to continue and a replacement had to be found. However, we were fortunate to engage Rachael Gallagher as her previous research was relevant to the investigation and she was able to deliver what was needed for the Case Study.

**Opportunities:**
This initial climate modelling research has provided an interesting new form of research not previously available. It is reasonably inexpensive and available to EAGA councils now that this project has established the contacts with the scientists. This opens the way forward for more bioclimatic modelling for indigenous and introduced species to assist councils with planning land management actions, in particular determining suitable tree species to plant and key weed species to control. In addition, councils could work together to provide more detailed maps of species distribution to contribute to future modelling.

**Potential for Future analysis/development?**

- Establishment of baseline data for species of interest.
- Monitoring for early signs of changes in distribution and community composition.
- Identifying the early indicators of change to look for.

# 6. Project learning, benefits and future directions

## Project Learning
- EAGA councils work together well in implementing projects but resource constraints often prevent the level of engagement and continuity that officers would like
- While the EAGA councils have similar biodiversity protection issues, they have very different levels of land management and resources. Yarra Ranges Council has the most extensive biodiversity and bushland assets to manage and the lowest rate-base. Therefore the importance of cooperative regional work is in developing models and frameworks that enable councils to consider the information needed to manage and maintain biodiversity assets.
- It was beneficial that the EAGA councils were all concerned with terrestrial land management, i.e. none are coastal councils that would have brought different challenges into the project and potentially made it more difficult to choose a Case Study project that worked for all.
- Climate change science can seem intangible to councils but the climate scientists were very accessible and willing to share their information and to assist where possible. Utilising the networks/contacts and good working relations established (particularly in science community) by the project will help to build rapport and robust discussion with science and research organisations to develop a system for generating climate change information that is useful to councils in an operational sense.
- Before this project, EAGA councils were largely uninformed about the potential impacts of climate change on their natural assets and were therefore ill-equipped to make long-term planning decisions.
- Not all councils are taking a proactive role in understanding and acting on climate change. This may be due to community feelings, elected officials or lack of understanding of the issues/impacts to enable its effective management prioritisation.
- There is a significant need to increase awareness of climate change issues, science and potential impacts through continuing projects like this one that investigate the issues and provide and knowledge base for councils to work from.

- Climate models are only one source of information that should be considered. It is also important to invest in on ground information collection and monitoring to increase knowledge about local climate change impacts.
- The use of a Project Officer was critical to the coordination and implementation of this project. Steering Committee members were actively involved in the project but unable to take on large aspects of the implementation due to their already considerable workloads outside of the project.
- A Project Officer dedicated to the project enabled the development of key relationships with education and scientific institutions to facilitate the research component of the project, a relationship/partnership which has not traditionally been formed between councils and research institutions.
- Maintenance of the relationship between councils and institutions will be key to the success of further research leading from the outcomes of this project.
- Climate change information is continually evolving and it is essential councils continue to monitor and understand new information and how it may affect actions. Those that fail to do so will be left behind.

## Project Benefits

- Integration of Climate Science (big picture thinking), with practical land management outcomes (local focus).
- Use of a bioclimatic tool that is available for all councils to assess their own key flora species (indigenous and exotic) to help them plan for long term success in biodiversity protection and land management.
- Increased awareness within councils as to the importance of considering climate change projections in long term strategic planning as well as operation works.
- The project process and outcomes provide a tool for councils to communicate about biodiversity and climate change impacts to other agencies and the community.
- Entry points into the science community to foster a partnership for ongoing work.
- The project brought together information on climate change issues in a relevant and accessible way. Councils can continue to build on this good base of knowledge.
- Groundbreaking project which can be replicated throughout the state in other councils and Greenhouse Action Alliances.
- Solidifying of networks and relationships between councils as a region.
- Flagship project for EAGA, enhancing profile and showing leadership to other councils.

## Future Directions

The development of this project has been an initial step to gain understanding around the issue of climate change in the EAGA region and to test the knowledge and current actions and abilities of local governments to effectively manage their biodiversity and bushland assets in a changing climate. The outcomes of this project are an advancement of understanding and clear future directions for action.

Based on the Steering Committee's analysis, there are key future directions for the next phase of this project:

1. Engage a Project Officer to support the EAGA council staff with:
    - climate change information/science updates
    - interpretations of climate change information to explain how and why it is important to councils and land management programs
    - maintaining contact with key climate researchers
    - implementing further research options from the proposed Case Study topics
    - continuing to bring together climate scientists and council strategic and operational staff
    - building on relationships with research institutions and look for opportunities to co-support new research and students

- disseminating the project information and tools to the wider Victorian councils
- developing communication strategies and materials for the EAGA councils (for internal and external audiences).

2. Continuing Climate Research by and for councils on:
- Impacts of changing climate on additional key flora, known weeds, potential weeds, threatened species habitat, cultural and other values
- The value of climate change impacts on local industry/ local economies (agriculture, horticulture, etc.)
- Climate change risk implications for community safety (bushfire, floods)
- Risk Management assessment of climate change impacts on infrastructure
- Impacts of bushland patch size; does it affect the ability to protect biodiversity in a changing climate?
- Impact of climate change on different EVCs; are they set to change; do we need to rethink how we define them?
- Stormwater management: reducing and coping with flooding and erosion, change in water storage needs to accommodate long dry periods between intense rainfall events
- Endangered species: which are most at risk and how can they be managed in a changing climate?

3. Increase Resources:
- Increased strategic planning and resources for climate change issues across all relevant council departments
- Seek joint grant opportunities between EAGA councils through Caring for our Country, NCCARF support etc.
- For on ground research, monitoring and management of biodiversity and bushland assets
- Further bioclimatic modelling for key flora species (indigenous and exotic).

4. Increase Communication:
- Within different departments of councils, from the executive and strategic to operational levels
- Between councils to provide increased opportunities to work together (provide project information on the MAV website)
- Between councils and other land management agencies- e.g. linking with CMA land management programs, Melbourne Water, Parks Victoria, Department of Sustainability and Environment
- Between councils and climate scientists
- Through new communication tools – presentations, websites, brochures etc.
- With the community – schools, landcare networks, environment groups etc.

5. Improve Land Management Actions with:
- Increased on ground monitoring of biodiversity assets and impacts
- Improved spot management of issues to avoid larger long term problems
- Triggers for updating operational plans more quickly:
  - incorporate new information on vulnerable species and required management
  - potential impacts of current and new weed species reported quarterly (not annual operational plans which might be too late for appropriate action to be most effective).
- Develop new management tools for biodiversity assessment and reporting - establish baseline data now to be able to monitor change and implement adaptive management techniques.

# 6. Acknowledgements

Representatives from four EAGA councils were regular contributors to the project's steering committee helping to direct and implement this project.  Their efforts were integral in the success of the project.

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# 7. Appendices

1:      Literature Review (Updated)
2a:     Climate Change Projections Paper (Completed July 2010)
2b:     CSIRO Climate Futures for Eastern Melbourne
2c:     CSIRO Climate Futures spreadsheet
3:      Issues Paper
4:      Case Study